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PHILOSOPHICAL TRANSACTIONS.

- I. *The Croonian Lecture. A farther investigation of the component parts of the Blood.* By Sir EVERARD HOME, Bart.
V. P. R. S.

Read November 4, 1819.

As the capacity of one individual is rarely able to bring to perfection different branches of science, it is no wonder that, in the investigation of so complex a subject as the component parts of the blood, HEWSON failed, HUNTER fell short in the attempt, and Dr. YOUNG, after the interesting discovery of the colouring matter being readily separated from the red globules, made no farther advance. This view of the subject, led me, at the time I ventured upon this enquiry, to engage as my associates, Mr. BAUER, whose microscopical observations have been too long put to the proof, to admit of their being disputed ; and Professor BRANDE, whose chemical researches, and the judgment with which they have been pursued, are fully established.

In two former Lectures, assisted by these skilful coadjutors, I have been enabled to prove, that the human blood in the

act of coagulation, evolves aeriform matter, so as to pervade the coagulum in every direction; and that such currents, passing through the serum, form permanent tubes, which are immediately afterwards filled with red blood, when the circumstances in which the coagulum is placed, admit of their being so.

In the present Lecture, I trust that I am enabled to make out the greater number, if not the whole, of the component parts of the blood.

My former experiments were made upon coagula recently formed from the blood, whether out of the body, or in the interstices of parts possessed of life. Upon the present occasion, I have taken an opposite course, and have examined the coagula formed in aneurismal tumors. It is to be understood, that in this disease of the arteries, the coats at the part diseased, yield to the impulse of the heart, and admit of being permanently dilated, so as to form a pouch, in which the blood that remains at rest, coagulates. This dilatation is gradual; and as the pouch enlarges, the coagulum is found to be made up of a succession of layers, affording an opportunity of observing the changes coagulated blood undergoes under such circumstances at different periods of time.

In the examination of the section of an aneurismal tumor in the microscope, Mr. BAUER found that the layer of the coagulum, in contact with the blood in circulation, was red in its colour, loose in its texture, and principally consisted of red globules from which the colour had been discharged, and remained diffused through the mass. Besides these globules, he saw others of a smaller size, which he had never met with in fluid blood, however frequently he had examined

it ; there was also a small quantity of a transparent elastic mucus insoluble in water. The newly discovered globules were $\frac{1}{2800}$ part of an inch in diameter, and their number in proportion of one to four of the large ones. The other layers, in proportion to the length of time coagulation had taken place, were become paler in colour, denser in texture, and what is most particularly deserving of notice in the present investigation, the proportion of the number of the small globules to the large ones gradually increased, and in the layer longest coagulated, they were in the proportion of four to one. In this layer there was also the largest proportion of the transparent elastic mucus.

The coat of the artery forming the pouch, appeared to be made up of zig-zag, or serpentine fibres, connected by the elastic mucus, in which many of the small globules were detected.

The condensed cellular membrane on the outside of the pouch, consisted of thin membranes or films, easily separated, and between them were found many small globules.

In the section of a large aneurismal tumor a deposit of crystals was met with. This uncommon appearance is represented in the annexed drawings. These salts, in the absence of Professor BRANDE, were analyzed by Mr. FARADAY, Assistant in the Laboratory of the Royal Institution : they are sulphate of lime with muriate and phosphate of soda ; salts usually met with in the blood, but probably never before seen in the form of crystals.

The discovery of small globules in aneurismal coagula, and the increase of their number in proportion to the dura-

tion of the coagulum, throws great light upon the materials of which the blood is composed.

Till this discovery was made, we knew of no globules in the blood but the red globules, either enclosed in their colouring matter, or deprived of it: indeed these smaller ones being held in solution in the serum, are only brought to view by the act of coagulation, and under the same circumstances we find the salts crystallize.

To ascertain whether these small globules constitute the substance thrown out in inflammation, Mr. BAUER examined a small portion of a mass of coagulable lymph taken from the vagina of an ass, where it had been deposited by a violent attack of inflammation; and another portion from the internal surface of an inflamed vein.* He found both substances made up of the small globules just discovered, mixed with a few red globules, deprived of their colouring matter. The globules which in a former Lecture were stated to have been produced in the serum, are now found to be similar to these, and had been held in solution in the serum when put into the tube.

The globules found by BASILIUS in the serum, after filtration through paper, must have been of the same kind.

In the prosecution of this enquiry, I procured the coagulum of some highly inflamed blood, as it is termed. The buff was very thick and firm, the lower portion loose in its texture. Mr. BAUER found the buff to consist almost wholly of the small globules, which I shall now call those of lymph,

* Both of these preparations are described in HUNTER'S Work upon the Blood, Inflammation, and Gun-shot Wounds.

and the lower portion principally of red globules ; so that the buffy appearance occurs when the lymph is so unusually slow in coagulating, that the red globules, which are so much larger and heavier, sink before that process has taken place.

In the absence of Professor BRANDE, Mr. FARADAY analyzed a portion of the buff, and of the part made up of red globules : having previously washed away the colouring matter, their chemical properties were in all respects the same.

That I might compare the structure of tumors, with that of the layers in aneurismal coagula, I got Mr. BAUER to examine in the microscope the structure of a tumor in the prostate gland, made up of rounded nodules ; the last formed of these was produced by the bursting of a small artery in the substance of the gland, so short a time before death, that the rupture of the vessel was distinctly seen when the parts were examined. He found the texture of the tumor soft and spongy ; it was made up almost wholly of red globules free from colour, very few of those of lymph, and some of the transparent elastic jelly ; the bands by which the nodules were separated, were composed of three-fourths of lymph, one-fourth of red globules from which the colour had been discharged, and a considerable proportion of the transparent jelly.

A tumor in the breast of long standing, of which the first formed part was hard and colourless, the last less compact and full of vessels or tubes, is shown in the annexed drawings. When its structure was examined in the microscope, the hard part was made up almost wholly of lymph globules, and elastic jelly ; the last made one-fourth of the whole. The

soft part consisted only of about one-fourth of lymph globules, the rest being red globules which had lost their colour.

The structure of such tumors is nearly allied to that of the layers in an aneurism. That these layers never become vascular, arises from the aeriform matter, evolved at the time that the blood coagulates, readily escaping into the circulating blood with which it is in contact.

To ascertain whether the proportion of aeriform matter in the blood is liable to vary, as well as to determine its nature, a very buffy coagulum was placed in the receiver of an air pump, with a syphon passing from the vessel containing it into a bottle filled with barytes water. The pump was worked, and the gas only came over in single bubbles, which occasioned a precipitation of carbonate of barytes. From a less buffy coagulum the gas came over in several bubbles at a time. When there was no buff, the gas was abundant, and the precipitation copious. To ascertain whether this gas is produced in the process of digestion, a pauper from one of our work-houses, an hour after eating a hearty dinner and drinking a pint of porter, was bled at the arm to six ounces. The coagulum was tested in the same manner as the others in the air pump, and at the same distance of time from that at which the blood was drawn, the gas passed through the syphon in a torrent, and there was a proportionate precipitation.

Carbonic acid gas, Professor BRANDE finds to be commonly met with in the urine; but in greater quantity immediately after a full meal.

The source from whence the carbonic acid gas is supplied, having been thus determined, an attempt was made to trace

the lymphatic and red globules to their origin. The pyloric portion of the stomach, and the duodenum, are filled with a glary mucus. Mr. BAUER found in this mucus a great number of lymph globules and a smaller number of red globules without colour, so that such globules appear to be produced in the earliest stage of digestion.

In the human species the produce of the process of digestion becomes white, and therefore is readily distinguished from any other fluids; in general it is first met with in this state in the beginning of the jejunum, but sometimes in the whole course of the duodenum; the readiness with which this substance is absorbed, and the velocity with which it is carried along the lacteal vessels, make it difficult to procure enough for examination till it reaches the glands in the mesentery, through which it must pass before it arrives at the thoracic duct.

An opportunity occurred of making this examination upon the contents of the mesenteric glands, of a man who died in a fit an hour after having eaten his dinner. Mr. BAUER having extricated some of the glands of the mesentery from the surrounding fat and cellular membrane, divided them transversely, when a quantity of milk-white fluid issued out. On examination, the white colour was found to depend upon an infinity of white globules floating in a clear, perfectly colourless fluid, in the same manner as the red globules do in the serum. About eight-tenths of these globules varied in size from the smallest speck to the size of the lymph globules, about one-tenth were of the size of red globules deprived of the colouring matter, and about one-twentieth were of the size of the red globules enclosed in their colouring matter. When

this fluid was left a few minutes on the glass, not only many new globules were formed, but the original small ones visibly increased on the field of the microscope, not by several globules uniting, but by accession of substance; and he watched several that enlarged to the full size of blood globules enclosed in their colouring matter: in that state they appeared more opaque; and when the glass was laid upon black paper, they appeared as distinctly to be milk-white, as the globules of the blood when the glass is laid upon white paper appeared to be bright red. When the fluid is diluted with water, no additional globules are produced, and the large ones are reduced in size, in the same manner as the red globules are, when their colouring matter is dissolved, and is leaving them. When there is a sufficient quantity of the fluid left to evaporate, ramifications are formed in every respect as distinct as those shown in a former Lecture, in the magnified drawing of a drop of human blood in the state of coagulation.

From the observations Mr. BAUER has had the opportunity of making upon the contents of the lacteal glands, he is satisfied that the full sized globules acquire that form in these glands, and that afterwards, so far as respects their external appearance, no change is necessary for their conversion into red globules, but their becoming red.

As the exposure of the blood to the air in its passage through the lungs, restores the brilliancy of colour that is lost in the circulation through the body, we can have no doubt that it is in the vessels of the lungs the blood receives its original hue.

EXPLANATION OF THE PLATES.

PLATE I.

Contains three figures; the first exhibits a transverse section of an aneurismal coagulum of the natural size; the other two represent the salts of the blood in a crystallized state, magnified five diameters.

Fig. 1. This section represents that part of the coagulum which lay in the bottom of the sac. It shows the different shades of colour of the layers according to their length of standing, and the crystallized salts in different parts of the coagulum.

Figs. 2 and 3. Different views of these crystals.

PLATE II.

Represents sections of a tumor taken from a patient in St. George's Hospital: there are seven figures.*

Fig. 1. The surface of the section of the natural size; one part is colourless; another appears to be very vascular.

* The following is an account of the case. The tumor was perceived when of the size of a pea: in six months it increased to that of an orange: in fourteen days more it doubled that size. Arsenic, 48 grs. to $\frac{3}{4}$ i. of water, was applied once in twenty-four hours for two days. The pain was too great to allow it to be renewed. In ten days the application was taken off, and the tumor was black and shrunk, but not dead to any depth. Equal parts of white arsenic and sulphur were applied once in twenty-four hours for two days: the pain was excessive. In fourteen days, one half of the tumor came away. The remaining surface resembled a coagulum of blood, soft and dark coloured. This came away next day, eight months and a half from the first appearance of the tumor. This last is the tumor of which a section is represented. The drawing was made twenty-four hours after it was removed, in which time it had undergone no change.

Figs. 2 and 3. Portions of the vascular part, magnified five diameters.

Fig. 4. A small portion of the colourless part, magnified 200 diameters, to show the lymph globules, of which it is made up.

Fig. 5. A similar portion of the vascular part, magnified in the same degree.

Fig. 6. A row of lymph globules, magnified 400 diameters.

Fig. 7. A row of blood globules deprived of their red colour; magnified 400 diameters.

Fig. 1.

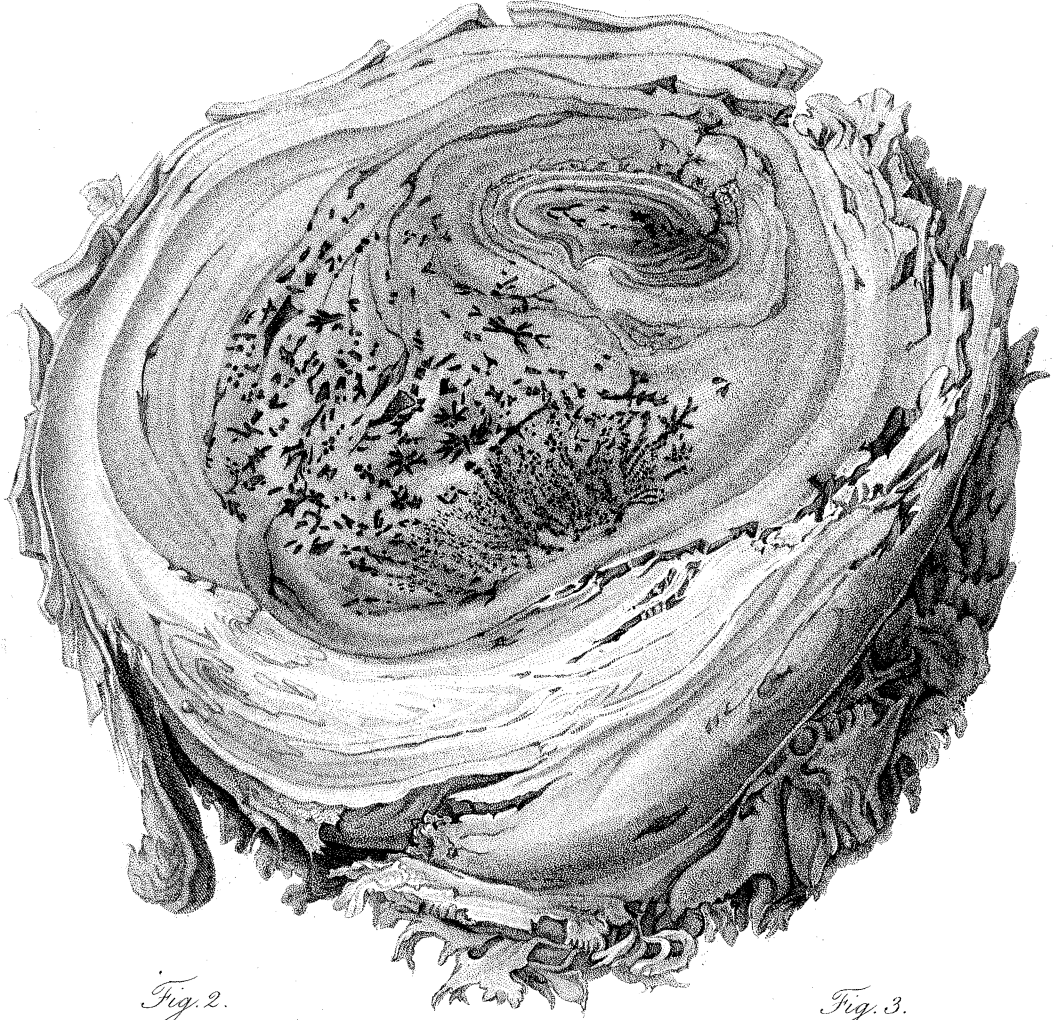


Fig. 2.

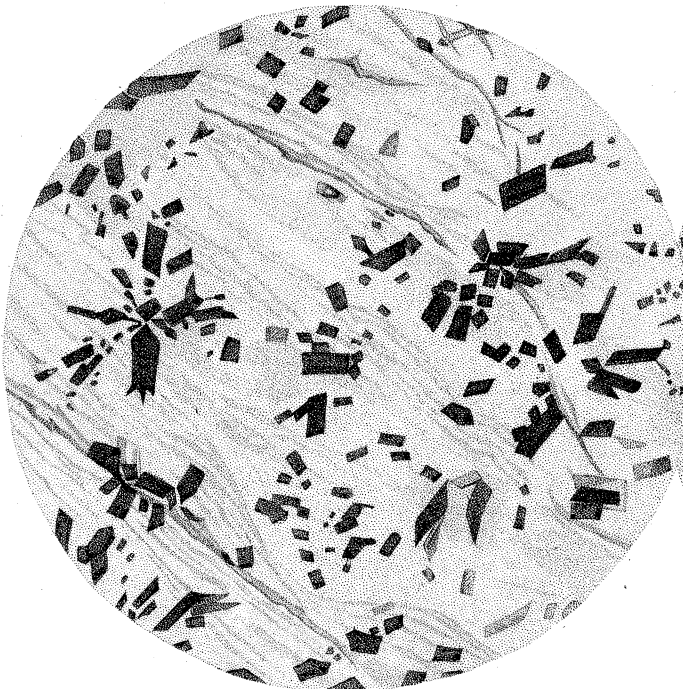


Fig. 3.

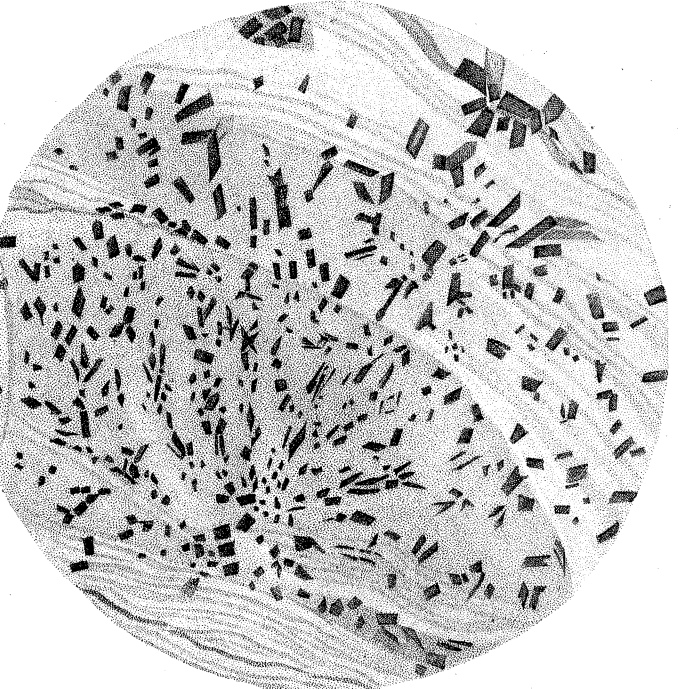


Fig. 1.

Natural size.

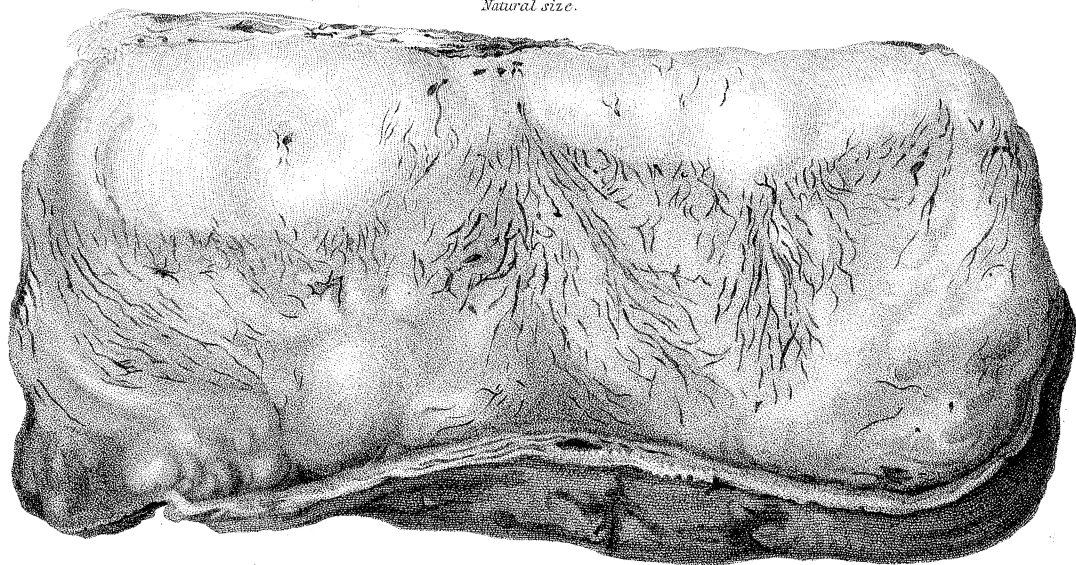


Fig. 2.

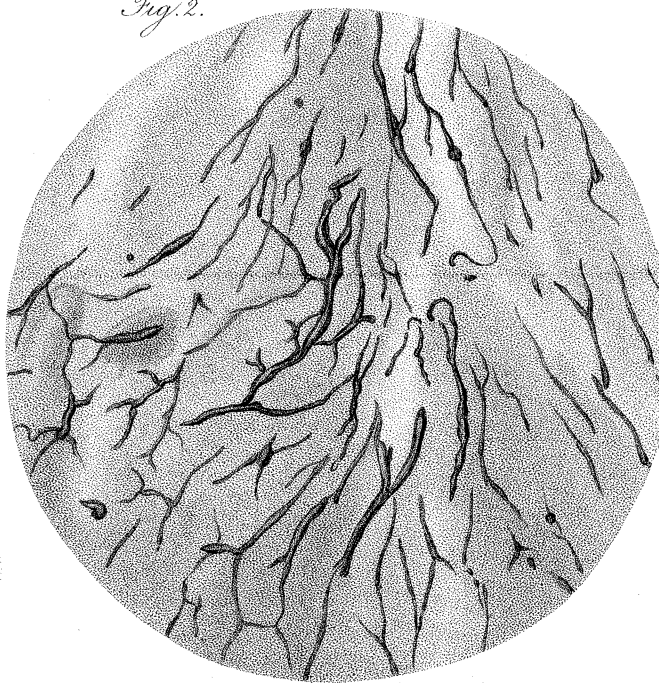


Fig. 3.

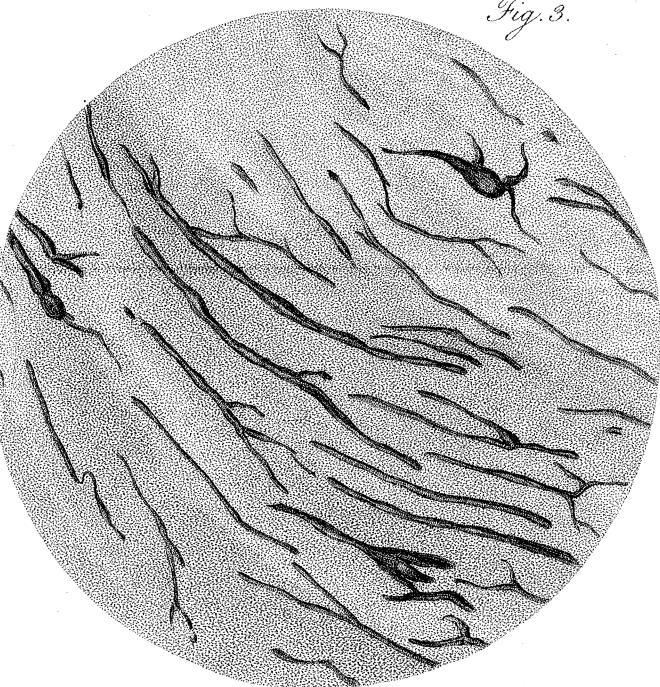


Fig. 4.

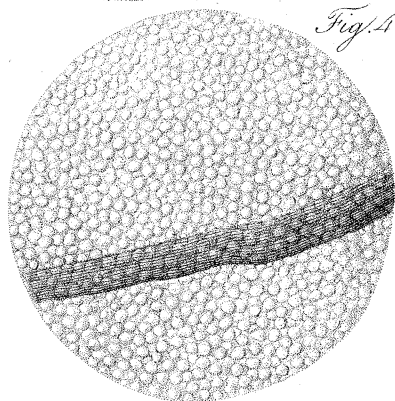


Fig. 6.



Fig. 5.

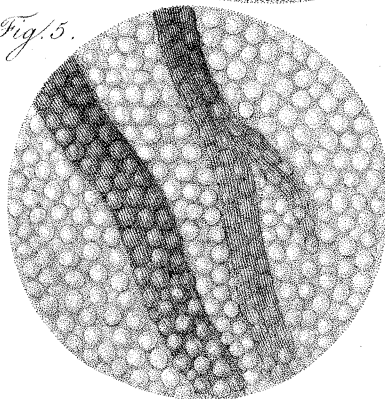


Fig. 7.

